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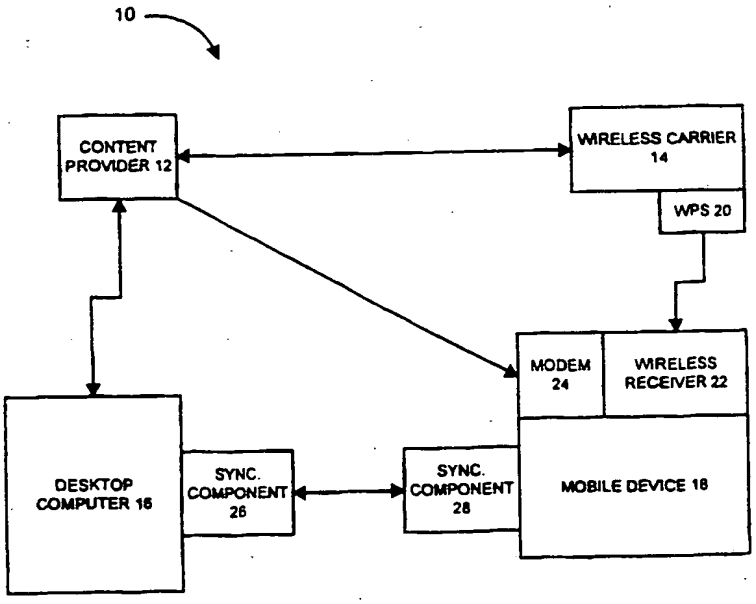
(71) Applicant: MICROSOFT CORPORATION [US/US]; One Microsoft Way, Redmond, WA 98052-6399 (US).

(72) Inventors: WECKER, Dave; 23908 - 22nd Drive, S.E., Bothell, WA 98021 (US). DEO, Vinay; 16732 N.E. 35th Street, Bellevue, WA 98008 (US). MILLER, John, Mark; 8026 N.E. 122nd Place, Kirkland, WA 98034 (US). TUNIMAN, David; 23044 N.E. 61st Street, Redmond, WA 98053 (US). O'LEARY, Michael, J.; 22823 N.E. 54th Street, Redmond, WA 98053 (US).

(74) Agents: KELLY, Joseph, R. et al.; Westman, Champlin & Kelly, P.A., Suite 1600, International Centre, 900 2nd Avenue South, Minneapolis, MN 55402-3319 (US).

(54) Title: SYSTEM FOR DELIVERING DATA CONTENT OVER A LOW BIT RATE TRANSMISSION CHANNEL



(57) Abstract

The present invention provides a system by which information content (250) is delivered to a mobile device (18). The web content (250) is divided into data (202) and script information (204). The script information (204) is used to operate on the data (202) to render the data (202) in a predetermined format.

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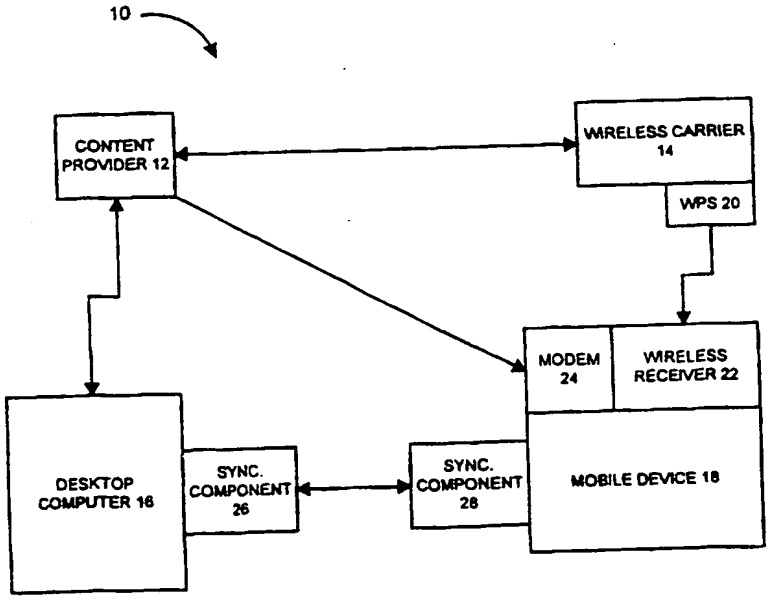

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SYSTEM FOR DELIVERING DATA CONTENT OVER A LOW BIT RATE TRANSMISSION CHANNEL

BACKGROUND OF THE INVENTION

The present invention relates to personal mobile computing devices commonly known as mobile devices. More particularly, the present invention relates to a system and method for delivering and receiving information on a mobile device.

Mobile devices are small electronic computing devices often referred to as personal digital assistants. Many such mobile devices are hand held devices, or palm-size devices, which comfortably fit within the hand. One commercially available mobile device is sold under the trade name HandHeld PC (or H/PC) having software provided by Microsoft Corporation of Redmond, Washington.

Generally, the mobile device includes a processor, random access memory (RAM), and an input device such as a keyboard and a display. The keyboard can be integrated with the display, such as where the keyboard is incorporated as a touch sensitive display. A communication interface is optionally provided and is commonly used to communicate with a desktop computer. A replaceable or rechargeable battery powers the mobile device. Optionally, the mobile device can receive power from an external power source that overrides or recharges the built-in battery.

In some prior applications, the mobile device is used in conjunction with a desktop computer. For example, the user of the mobile device may also have access to, and use, a desktop computer at work or at home, or both. The user typically runs the same types of applications on both the desktop computer and on

the mobile device. Thus, it is quite advantageous for the mobile device to be designed to be coupled to the desktop computer to exchange information with, and share information with, the desktop computer.

Another technique for providing information to such mobile devices is through a wireless transmission link. Such information can include electronic mail or news, weather, sports, traffic and local event information. The information is typically obtained from a desktop computer connected to the Internet and delivered over a wired connection. However, it may be desirable to deliver such information over a wireless connection as well. A wireless receiver on the mobile device can act to receive information as it is being sent to the mobile device.

There is presently no reasonable way to deliver push style content (such as hypertext mark-up language (HTML) content provided on a global network such as the internet and world wide web) to such devices in a wireless manner and in an open and available architecture. The bit rate of conventional wireless channels is very low. Thus, the delivery of very large content (such as HDML content) is highly impractical.

One conventional type of approach to delivering such information is to rewrite the content into a device friendly format, such as HTML. The content is then obtained over a pull-style model. Another approach currently being used to deliver information via a wireless medium is a closed model. In a closed model, a content provider can only provide content which is written in a format suitable for receipt by a specific device implementing a specific type of

software. This means that the vast majority of web content is unavailable for viewing on such devices.

SUMMARY OF THE INVENTION

The present invention provides a system by which information content is delivered to a mobile device. The web content is divided into data and script information. The script information is used to operate on the data to render the data in a predetermined format.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified block diagram illustrating one embodiment of a mobile device in a system in accordance with the present invention.

FIG. 2 is a more detailed block diagram of one embodiment of a mobile device shown in FIG. 1.

FIG. 3 is a simplified pictorial illustration of one emboidment of the mobile device shown in FIG. 2.

FIG. 4 is a simplified pictorial illustration of another embodiment of the mobile device shown in FIG. 2.

FIG. 5 is a block diagram of one embodiment of a desktop computer in accordance with one aspect of the present invention.

FIG. 6 is a flow diagram illustrating the operation of a mobile device in accordance with one aspect of the present invention.

FIG. 7 illustrates a general data structure of a packet transmitted to the mobile device in accordance with one aspect of the present invention.

FIG. 8 is a more detailed flow diagram illustrating a routing and translator layer and the preparation of packets for transmission in accordance with one aspect of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a system 10 in which the present invention is illustratively implemented. System 10 includes content provider 12, wireless carrier 14, desktop computer 16 and mobile device 18. Content provider 12 provides any suitable type of data from a database or other data source. For example, content provider 12 is discussed hereinafter as a provider of internet world wide web content. In the preferred embodiment, the content is provided in a standard format, such as HTML, JPEG, GIF, WAV, etc. The web content is also preferably described in a channel definition format (CDF) file. A single portion of content (such as a web page or a web site) is referred to herein as a mobile channel.

A mobile channel is a self describing web site that contains all the information necessary for efficient download of web content to mobile device 18. Three components are provided in a preferable mobile channel. The components include a channel definition format (CDF) file, a set of script files to render the channel, and a set of data files to be rendered. The CDF files are described in greater detail in co-pending U.S. patent application serial number _____, entitled CHANNEL DEFINITION ARCHITECTURE EXTENSION, and hereby fully incorporated by reference. Briefly, the CDF is an inventory of content contained on the mobile channel.

The script files contain script which defines templates which specify the appearance of the data on the screen of mobile device 18. Scripts are preferably written in visual basic script (VBS).

The data files correspond to one or more script

files and include data which is indicative of the substantive content of the channel to be rendered. The data is packaged in small and simple text files. All of this information is used to define web content.

Wireless carrier 14 is described in greater detail later in the application. Briefly, however, wireless carrier 14 is configured to receive web content from the web content provider 12 via dial-up or direct internet connection, or a network connection. Wireless carrier 14 also includes a wireless push server 20. Server 20 splits the content received from content provider 12 into pieces which are compatible with the particular type of transport being used by wireless carrier 14. For instance, server 20 may split the data such that it conforms to maximum packet size constraints, character set requirements, etc. for the channel type or transport type being used. Prior to transmission, the data is preferably translated to a different form. As is described in greater detail later in the application, such translation may include compression, encryption, encoding and then packaging. Once the data has been split appropriately such that it conforms to the transport constraints, the data is then configured for transmission over the air through a wireless network (such as through a paging channel) to be received directly on mobile device 18. The transmitted data is received by a wireless receiver and driver component 22 on mobile device 18 where the data is prepared for use by mobile device 18.

Mobile device 18 also preferably includes a modem 24. Thus, rather than being transmitted through wireless carrier 14, the web content can be

transmitted directly from web content provider 12 through a direct dial-up modem connection to mobile device 18.

Desktop computer 16 will also be described in greater detail later in the specification. Briefly, however, desktop computer 16 is preferably provided with a standard web browser, such as Internet Explorer 4.0 commercially available from the Microsoft Corporation of Redmond, Washington. That being the case, the users of desktop 16 can preferably subscribe to channels in a standard fashion which provide the user with certain channel content which can be browsed off-line or on-line. Desktop computer 16 is preferably provided with a loadable transport (in accordance with one aspect of the present invention) that accesses the script files and acts on the corresponding data file (in accordance with the script) to render the content where desktop computer 16 renders the data. Desktop computer 16, through the transport, can periodically retrieve or receive new and updated script, data and CDF files either for further transmission to mobile device 18 or simply for rendering the data. The script, data and CDF files can be transmitted either together or independently of one another. Since scripting files typically need updating much less frequently than the data files, this provides the user with the ability to view the web content on the desktop (off-line) while requiring only small amounts of bandwidth for incremental updating of the data files.

Desktop computer 16 also preferably includes synchronization component 26. Briefly, synchronization component 26 is configured to interact

with a similar synchronization component 28 on mobile device 18 such that files which are the subject of synchronization can be synchronized from desktop computer 16 to mobile device 18, or vice versa. Once synchronized, both files (those on computer 16 and mobile device 18) contain up to date information.

More specifically, mobile device 18, in the preferred embodiment, can be synchronized with either desktop computer 16, or another mobile device 18, or both. In that instance, properties of objects stored in an object store on mobile device 18 are similar to properties of other instances of the same object stored in an object store on desktop computer 16 or another mobile device 18. Thus, for example, when a user changes one instance of an object stored in an object store on desktop computer 16, the second instance of that object in the object store of mobile device 18 is updated the next time mobile device 18 is connected to desktop computer 16 so that both instances of the same object contain up-to-date data. This is referred to as synchronization.

In order to accomplish synchronization, synchronization components 26 and 28 run on both mobile device 18 and desktop computer 16 (or another mobile device 18). The synchronization components communicate with one another through well defined interfaces to manage communication and synchronization.

Mobile device 18 is also preferably provided with a script interpreter which, in one preferred embodiment, is the same as or similar to the loadable transport on desktop computer 16. Such a transport may be, for example, a down-sized visual basic

interpreter, which receives and interprets the formatting script. The script is associated with a certain data file (typically a text file) that holds the raw data for the web content. Thus, the script interpreter operates on the data associated with a given script to provide a rendering of the web content to the user of mobile device 18.

By separating the script from the data in the web content, web content can be transmitted to mobile device 18 over very low bit rate channels. The script will only typically need to be transmitted very infrequently. Also, since an individual file is typically much smaller than the script files, the data can be updated quite frequently, giving the user of mobile device 18 updated web content information, without transmitting new script. Thus, the separation of the script and data allows the transmission of web content information in a very efficient manner over low bit rate channels.

It is worth noting that, in the preferred embodiment, while mobile device 18 can be coupled to desktop computer 16, it can be also coupled to another mobile device 18. This connection can be made using any suitable, and commercially available, communication link and using a suitable communications protocol. For instance, in one preferred embodiment, mobile device 18 communicates with either desktop computer 16 or another mobile device 18 with a physical cable which communicates using a serial communications protocol. Other communication mechanisms are also contemplated by the present invention, such as infra-red (IR) communication or other suitable communication mechanisms.

FIG. 2 is a more detailed block diagram of mobile device 18. Mobile device 18 preferably includes microprocessor 30, memory 32, input/output (I/O) components 34, desktop communication interface 36 wireless receiver 37 and antenna 39. In a preferred embodiment, these components of mobile 10 are coupled for communication with one another over a suitable bus 38.

Memory 32 is preferably implemented as non-volatile electronic memory such as random access memory (RAM) with a battery back-up module (not shown) such that information stored in memory 32 is not lost when the general power to mobile device 18 is shut down. A portion of memory 32 is preferably allocated as addressable memory for program execution, while another portion of memory 32 is preferably used for storage, such as to simulate storage on a disc drive.

Memory 32 includes operating system 40, an application program 42 (such as a personal information manager or PIM) as well as an object store 44. During operation, operating system 40 is preferably executed by processor 30 from memory 32. Operating system 40, in one preferred embodiment, is a Windows CE brand operating system commercially available from Microsoft Corporation. The operating system 40 is preferably designed for mobile devices, and implements database features which can be utilized by PIM 42 through a set of exposed application programming interfaces and methods. The objects in object store 44 are preferably maintained by PIM 42 and operating system 40, at least partially in response to calls to the exposed application programming interfaces and methods.

I/O components 34, in one preferred embodiment, are provided to facilitate input and output operations from a user of mobile device 18. I/O components 34 are described in greater detail with respect to FIGS. 3 and 4.

Desktop communication interface 36 is optionally provided as any suitable communication interface. Interface 36 is preferably used to communicate with desktop computer 16, content provider 12, wireless carrier 14 and optionally another mobile device 18, as described with respect to FIG. 1. Thus, communication interface 36 preferably includes synchronization components 28 for communicating with desktop computer 16 and modem 24 for communicating with content provider 12. Wireless receiver and driver 22 are used for communicating with wireless carrier 14.

FIG. 3 is a simplified pictorial illustration of one preferred embodiment of a mobile device 10 which can be used in accordance with the present invention. Mobile device 10, as illustrated in FIG. 3, can be a desktop assistant sold under the designation H/PC having software provided by the Microsoft Corporation. In one preferred embodiment, mobile device 18 includes a miniaturized keyboard 43, display 45 and stylus 46. In the embodiment shown in FIG. 3, display 45 is a liquid crystal display (LCD) which uses a contact sensitive display screen in conjunction with stylus 46. Stylus 46 is used to press or contact the display 45 at designated coordinates to accomplish certain user input functions. Miniaturized keyboard 43 is preferably implemented as a miniaturized alpha-numeric keyboard, with any suitable and desired function keys which are also provided for accomplishing certain user

input functions.

FIG. 4 is another simplified pictorial illustration of the mobile device 18 in accordance with another preferred embodiment of the present invention. Mobile device 18, as illustrated in FIG. 4, includes some items which are similar to those described with respect to FIG. 3, and are similarly numbered. For instance, mobile device 18, as shown in FIG. 4, also includes touch sensitive screen 45 which can be used, in conjunction with stylus 46, to accomplish certain user input functions. It should be noted that the display 45 for the mobile device as shown in FIGS. 3 and 4 can be the same size as one another, or different sizes from one another, but would typically be much smaller than a conventional display used with a desktop computer. For example, displays 45 shown in FIGS. 3 and 4 may be defined by a matrix of only 240X320 coordinates, or 160X160 coordinates, or any other suitable size.

The mobile device 18 shown in FIG. 4 also includes a number of user input keys or buttons (such as scroll buttons 47) which allow the user to scroll through menu options or other display options which are displayed on display 45, or which allow the user to change applications, without contacting display 45. In addition, the mobile device 18 also shown in FIG. 4 also preferably includes a power button 49 which can be used to turn on and off the general power to the mobile device 18.

It should also be noted that, in the embodiment illustrated in FIG. 4, mobile device 18 includes a hand writing area 51. Hand writing area 51 can be used in conjunction with stylus 46 such that the user

can write messages which are stored in memory 42 for later use by the mobile device 18. In one illustrative embodiment, the hand written messages are simply stored in hand written form and can be recalled by the user and displayed on the display screen 45 such that the user can review the hand written messages entered into the mobile device 18. In another preferred embodiment, mobile device 18 is provided with a character recognition module such that the user can enter alpha-numeric information into mobile device 18 by writing that alpha-numeric information on area 51 with stylus 46. In that instance, character recognition module in the mobile device 18 recognizes the alpha-numeric characters and converts the characters into computer recognizable alpha-numeric characters which can be used by the application programs 42 in mobile device 18.

FIG. 5 and the related discussion are intended to provide a brief, general description of a suitable desktop computer 16 in which portions of the invention may be implemented. Although not required, the invention will be described, at least in part, in the general context of computer-executable instructions, such as program modules, being executed by a personal computer 16 or mobile device 18. Generally, program modules include routine programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that desktop computer 16 may be implemented with other computer system configurations, including multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe

computers, and the like. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

With reference to FIG. 5, an exemplary system for implementing desktop computer 16 includes a general purpose computing device in the form of a conventional personal computer 16, including processing unit 48, a system memory 50, and a system bus 52 that couples various system components including the system memory 50 to the processing unit 48. The system bus 52 may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. The system memory 50 includes read only memory (ROM) 54 a random access memory (RAM) 55. A basic input/output system (BIOS) 56, containing the basic routine that helps to transfer information between elements within the desktop computer 16, such as during start-up, is stored in ROM 54. The desktop computer 16 further includes a hard disk drive 57 for reading from and writing to a hard disk (not shown) a magnetic disk drive 58 for reading from or writing to removable magnetic disk 59, and an optical disk drive 60 for reading from or writing to a removable optical disk 61 such as a CD ROM or other optical media. The hard disk drive 57, magnetic disk drive 58, and optical disk drive 60 are connected to the system bus 52 by a hard disk drive interface 62, magnetic disk drive interface 63, and an optical drive interface 64,

respectively. The drives and the associated computer-readable media provide nonvolatile storage of computer readable instructions, data structures, program modules and other data for the desktop computer 16.

Although the exemplary environment described herein employs a hard disk, a removable magnetic disk 59 and a removable optical disk 61, it should be appreciated by those skilled in the art that other types of computer readable media which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks (DVDs), Bernoulli cartridges, random access memories (RAMs), read only memory (ROM), and the like, may also be used in the exemplary operating environment.

A number of program modules may be stored on the hard disk, magnetic disk 59, optical disk 61, ROM 54 or RAM 55, including an operating system 65, one or more application programs 66 (which may include PIMs), other program modules 67 (which may include synchronization component 26), and program data 68. A user may enter commands and information into the desktop computer 16 through input devices such as a keyboard 70, pointing device 72 and microphone 74. Other input devices (not shown) may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit 48 through a serial port interface 76 that is coupled to the system bus 52, but may be connected by other interfaces, such as a sound card, a parallel port, game port or a universal serial bus (USB). A monitor 77 or other type of display device is also connected to the system bus 52 via an interface, such as a video adapter 78.

In addition to the monitor 77, desktop computers may typically include other peripheral output devices such as speaker 75 and printers.

The desktop computer 16 may operate in a networked environment using logic connections to one or more remote computers (other than mobile device 18), such as a remote computer 79. The remote computer 79 may be another personal computer, a server, a router, a network PC, a peer device or other network node, and typically includes many or all of the elements described above relative to desktop computer 16, although only a memory storage device 80 has been illustrated in FIG. 4. The logic connections depicted in FIG. 4 include a local area network (LAN) 81 and a wide area network (WAN) 82. Such networking environments are commonplace in offices, enterprise-wide computer network intranets and the Internet.

When used in a LAN networking environment, the desktop computer 16 is connected to the local area network 81 through a network interface or adapter 83. When used in a WAN networking environment, the desktop computer 16 typically includes a modem 84 or other means for establishing communications over the wide area network 82, such as the Internet. The modem 84, which may be internal or external, is connected to the system bus 52 via the serial port interface 76. In a network environment, program modules depicted relative to desktop computer 16, or portions thereof, may be stored in the remote memory storage devices. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

Desktop computer 16 runs operating system 65 that

is typically stored in non-volatile memory 54 and executes on the processor 48. One suitable operating system is a Windows brand operating system sold by Microsoft Corporation, such as Windows 95 or Windows NT, operating systems, other derivative versions of Windows brand operating systems, or another suitable operating system. Other suitable operating systems include systems such as the Macintosh OS sold from Apple Corporation, and the OS/2 Presentation Manager sold by International Business Machines (IBM) of Armonk, New York. Application programs are preferably stored in program module 67, in volatile memory or non-volatile memory, or can be loaded into any of the components shown in FIG. 5 from a floppy diskette 59, CDROM drive 61, downloaded from a network via network adapter 83, or loaded using another suitable mechanism.

A dynamically linked library (DLL), comprising a plurality of executable functions is associated with PIMs in the memory for execution by processor 48. Interprocessor and intercomponent calls are facilitated using the component object model (COM) as is common in programs written for Microsoft Windows brand operating systems. Briefly, when using COM, a software component such as a DLL has a number of interfaces. Each interface exposes a plurality of methods, which can be called individually to utilize different services offered by the software component. In addition, interfaces are provided such that methods or functions can be called from other software components which optionally receive and return one or more parameter arguments.

In general, the DLL associated with the

particular PIM is designed specifically to work in conjunction with that PIM and to expose desktop synchronization interfaces that function as described in more detail above according to a synchronization protocol. The DLL, in turn, calls interfaces exposed by the PIM in order to access data representing individual properties of objects maintained in an object store. The object store 6, of course, can reside in any one of the suitable memory components described with respect to FIG. 4.

ARCHITECTURE BLOCK DIAGRAM

FIG. 6 is a block diagram illustrating the functional architecture of mobile device 18. FIG. 6 shows similar items to those previously shown in the specification. Similar items are similarly numbered. FIG. 6 illustrates that mobile device 18 receives web content information either via synchronization component 26, wireless receiver (radio receiver and driver) 22 or modem 24. In any of those cases, the CDF files as well as the script templates and data files, indicated by blocks 202 and 204 are eventually provided to cache memory 206. Where the web content information is received through synchronization component 26, the script templates and data files may are not be encrypted or encoded or otherwise formatted in the same fashion as they are for transmission over a wireless or modem channel. Therefore, the script templates 204 and data files 202 are provided directly to cache manager 208. Cache manager 208 receives the script templates and data files and provides them to cache memory 206. Cache manager 208 includes memory manipulation and timing components as well as data transfer components, which are suitable for

transferring the script templates and data files to a particular location in cache memory 206, and to track that location.

If, on the other hand, the web content is received over wireless receiver and driver 22 or modem 24, additional processing steps must be undertaken prior to caching the data. Wireless receiver and driver 22 is a physical layer that receives and filters messages and generates wake-up events to mobile device 18. In one preferred embodiment, as is described later with respect to FIG. 8, the information transmitted is first translated (such as compressed, encrypted, encoded and packaged) before transmission. Thus, the data must be translated back to its original form prior to further use by mobile device 18. Therefore, the data is first provided to message router 210. Message router 210 acts to record the message and route the received message to a translation layer 209. In FIG. 6, translation layer 209 includes unpackager and joiner component 212, a group of additional translators collectively labeled 214 and a further routing component 216.

Unpackager and joiner block 212 acts to receive, unpack and order a group of packets being transmitted. The unpackager rejoins packets of any long messages which were split up by wireless carrier 15. The ordered data is provided to translation components 214.

Translation components 214 act to reformat or translate the data into appropriate form to be handled by content handler 216. For example, once the packets which comprise a message have been unpacked and rejoined by unpacker and joiner 212, translation

components 214 may typically decompress, decrypt and decode those packets.

Content handler 216 delivers the unpacked, joined and translated message to the appropriate registered destination (i.e., to the appropriate application or other functional block) on mobile device 18. In the embodiment illustrated in FIG. 5, content handler 216 provides the information to cache manager 208 which stores it in cache 206.

When the user wishes to off-line browse the web content stored in cache 206, the user launches an appropriate application program indicated by channel browser block 218 in FIG. 5. Channel browser 218 preferably generates suitable user interfaces on display 45 which provide the user with the ability to choose a certain channel to be viewed.

Channel browser 218 is configured to interact with a loadable transport 220 which is, in turn, coupled to cache manager 208. In response to the user requesting to view information provided via the chosen channel, loadable transport 220 requests cache manager 208 to retrieve the corresponding web content information (in the form of script templates and data files) from cache 206. The desired script templates 204 and data files 202 are provided from cache manager 208 to loadable transport 220.

The script interpreter in transport 220 is preferably a visual basic script interpreter which interprets script templates 204 and acts on data files 202 to provide a desired rendering of the web content. In the embodiment illustrated in FIG. 5, the web content is rendered as a conventional hypertext mark-up language (HTML) page 224. Loadable transport 220

then provides the HTML page rendering to channel browser 218 for viewing by the user of mobile device 18 on display 45.

INFORMATION LOGGING

One aspect of the present invention enables logging of desired information for use by content provider 12. In other words, by providing an entry in the CDF file, the content providers can tag certain items which they want to track (i.e., they can tag certain items for which they would like to know when, and for how long, those items were viewed by any given user). The present invention implements this functionality.

For example, when the user launches channel browser 218, and requests information from loadable transport 220, loadable transport 220 determines whether the requested information includes the appropriate CDF tag indicating that the content provider wishes to log information regarding the time and duration which the information was viewed. If so, loadable transport 220 logs information which is representative of the time and duration that the information was viewed by the user. This information is stored in cache 206 in a location which corresponds to that particular web content information.

The next time mobile device 18 is synchronized with desktop computer 16, not only is mobile device 18 updated with the current web content received by desktop computer 16, but desktop computer 16 is updated with the current logging information maintained by mobile device 18. Similarly, the next time the browser on desktop computer 16 accesses the appropriate web content from content provider 12, the

logging information is transmitted from desktop computer 16 to content provider 12. In one preferred embodiment, since the browser on desktop computer 16 is Internet Explorer 4.0, logging information which has been synchronized to desktop computer 16 is transmitted to content provider 12 when the scheduler of Internet Explorer 4.0 is next invoked on desktop computer 16.

DATA STRUCTURE AND FILTERING

FIG. 7 illustrates one embodiment of a packet of web content data received by radio receiver and driver 10. The radio receiver can preferably receive messages of substantially any format. Many different types of header formats can be defined for receipt by the radio. FIG. 7 gives but one illustrative type of packet format.

Packet 230 preferably includes a plurality of portions, such as radio transport header 232, group and topic filtering bytes 234, routing header 236 and data 238. The radio transport header 232 preferably includes address information. The address information is an identifier used to send a radio message to radio receiver 22 (or any other similar type of radio card). For example, in one common commercially available paging transmission protocol, the address information in radio transport header 232 comprises a capcode. The capcode refers to a storage location on the physical hardware radio card device 22 that stores addressing information. The radio transport header 232, in one preferred embodiment, supports sixteen different addresses. Radio receiver and driver 22 filters and discards any messages which do not match any of the addresses. If a match is observed, then

radio receiver 22 has detected a message potentially addressed to it, and must receive and further process the message. The message is then passed to message router 210 which determines, in conjunction with translation layer 209, which components on the mobile device 18 are necessary to process the message.

Group and topic filtering bytes 234 are also preferably provided. A group, as referred to herein, is a subclass of an address that is used in accordance with the present invention to extend the filtering capability of an address. Further, a topic is a subclass of a group, which is also provided to extend the filtering capability of the address and group information.

It should be noted that messages arriving at radio receiver and driver 22 with an appropriate address may not have group and topic filtering bytes 234 pre-appended thereto. If those bytes are present, however, the driver in radio receiver and driver 22 operates to filter the message based on the group and topic filtering bytes.

The driver in radio receiver and driver 22 implements logic which first examines packet 230 to determine whether any group and topic filtering bytes 234 are included in packet 230. In a preferred embodiment, the driver in radio receiver and driver 22 supports a library which includes a function AnalyzeMessage(). The AnalyzeMessage function isolates service group codes and other information in the incoming message. If group and topic filtering bytes are present, then the group and topic filtering functions must be performed.

In the preferred embodiment, mobile device 18

includes a memory which contains a group table as described in greater detail in the above-incorporated applications. Briefly, the group table contains entries of service groups, each of which can be associated with any suitable address. Also, there can preferably be any suitable number of service groups associated with one address. Thus, in the preferred embodiment, group entries in the group table are sorted by address numbers, then by service group codes. The content of one preferred embodiment of the group table is set out in more detail in the above-referenced application.

If group or topic filtering bytes are detected, then the driver in radio receiver and driver 22 searches the group table to determine whether the service group code detected in packet 230 is listed in the group table, and whether it is active or inactive. If the service group code is not found in the table, or if it is found but it has been deactivated (or disabled) then the driver 22 discards the message and no further processing is done with respect to that message. However, if driver 22 determines that the group and topic filtering bytes 234 are included in the group table, then it is determined that the message was intended for that particular mobile device 18 and further processing continues.

Since all of this group and topic filtering is done at the level of driver 22, it occurs quite low in the protocol stack, or system architecture, of mobile device 18. Thus, filtering occurs early on in the process and the storage space required for the address and message is quite low. In addition, since the driver, itself, performs much of this filtering, the

group and topic filtering bytes 234 allow any application running on mobile device 18 to pass correct filtering information down to the group and topic tables for filtering at the level of driver 22. This significantly improves power consumption over previous designs because the messages do not need to be received, processed, and passed all the way up to the application level in the protocol stack, or architecture, of mobile device 18 before being filtered.

TRANSMISSION AND TRANSLATION ARCHITECTURE

FIG. 8 is a more detailed block diagram illustrating the transmission of data packets from wireless push server (WPS) component 20 to mobile device 18. Wireless push server 20 preferably includes web content cache 250, scheduler 252, translation layer 254, packager 256 and radio transmitter 258. Translation layer 254 preferably includes any suitable and desired number of translators. The translators are preferably used to operate on the web content (e.g., the data files, script files and CDF files) and provide the content, in a desired form, to packager 256 of radio transmitter 258 for transmission to mobile device 18. In the embodiment shown in FIG. 8, translation layer 254 includes compressor 260, encrypter 262 and encoder 264.

FIG. 8 also shows a portion of mobile device 18 in greater detail. Similar items are similarly numbered to those shown in FIG. 6. However, FIG. 8 illustrates translator layer 209 in greater detail. Translator layer 209 preferably includes a desired number and type of translators which operate to

reverse the translations performed in translator layer 254 on WPS 20. Thus, the embodiment shown in FIG. 8 includes unpackager 212, decoder 266, encrypter 268, and decompressor 270.

In operation, scheduler 252 periodically accesses web content cache 250 to provide updates, or additional web content, to mobile device 18. That information is first provided to translation layer 254. Each translator in translation layer 254 preferably performs the translation operation on the incoming data, and attaches an identifier, such as a header or a tag, to the data output thereby to indicate the type of translation performed. For instance, in the preferred emboidment, a portion of the web content which has been extracted from web content cache 250 by scheduler 252 (and prepared for translation layer 254 by scheduler 252) is first provided to compressor 260. Compressor 260 compresses the blob of information received thereby and attaches a four-byte header to identify the compression scheme used to compress the data. Compression is preferably done before encryption because pure text typically provides better compression than encrypted text.

Encrypter 262 receives the compressed data from compressor 260 and encrypts the output of compressor 260 and also attaches a four byte header to identify the encryption scheme used to encrypt the data. Encrypter 262 then provides encrypted data to encoder 264.

Encoder 264 encodes the output of encrypter 262 to convert the data stream into a stream consisting of characters suitable for transmission over the chosen wireless medium. For example, where the wireless

medium is a conventional paging channel, encoder 264 encodes the data into a stream consisting of printable ASCII characters only, so that it may be transmitted over the wireless link. Encoder 264 also attaches a four byte header to the data to identify the particular encoding scheme used to encode the data.

As described in greater detail above, packager 256 splits the output of encoder 264 into smaller packages suitable for transmission over the wireless link. Packager 256 attaches a header in front of the data packet so that the packets can be identified uniquely by the receiver of the information. For example, if the data input to translation layer 254 is first compressed, then encrypted, then encoded, the output of encoder 264 can be represented by:

(Encodingscheme, [EncryptionID {CompressionID, Data}]).

Thus, the packager takes the above data and produces packets generally in the form shown in FIG. 7 and given by:

{Hdr, data}, {Hdr, data}. . . {Hdr, data}

Packager 256 (which can also be viewed as a translator) provides the data and headers to radio transmitter 258 which transmits the data to radio receiver and driver 22. More specifically, the packager 256 breaks input data from content provider 12 into a number of packets somewhere between approximately 128 and 500 bytes in size depending on the particular carrier. Each packet is sent to a paging gateway (e.g, radio transmitter 258), such as by the internet, e-mail, wireless carrier or via modem. Packets can be sent down the pager channel in any order.

In one preferred embodiment, each record or packet contains 11-23 bytes of packet header information and N-bytes of packet data information generally of the form of packet 230 illustrated in FIG. 7. The radio transport header in the packet header information preferably includes an IP address, a sequence number, a packet number and a number of optional headers (e.g., group and topic filtering bytes 234 and routing header 236).

The IP address is the address of the service provider. The sequence number provides a particular sequence number for a packet stream being transmitted. The IP address and the sequence number (in combination) provide a unique identification to the packet stream and allow a receiver, such as mobile device 18, to assemble multiple packet streams arriving in a multiplex manner.

Radio receiver and driver 22 filters the data, as discussed above, and provides data to be received to router 210. Router 210 examines the header information on each packet. The header information gives router 210 an indication as to which translator needs to be invoked to operate on the data. In the embodiment shown in FIG. 8, the translators 212, 266, 268 and 270 are simply provided in reverse order as translators 256, 260, 262 and 264. The router maintains a table of all available translators in reference to the dynamically linked libraries (DLLs) of those translators. The four byte header or tag is used to locate the appropriate translator. The translator is responsible for removing this tag and dispatching or returning the translated data.

Most of the translators are part of a chain of

translators in which the output of the translator can be fed to another translator. This provides flexibility to the content provider since they can alter the sequence of translators to their needs and particular data. However, translators can also be provided which consume the input in the sense that they place the outputs somewhere else in the system and thereby stop the translation chain.

The router continues to apply translators until the article is consumed by one of the terminating translators. In one preferred emboidment, when no remaining tags or headers are found and the article is still not consumed, then the data is passed onto the e-mail inbox 272.

Thus, router 210 obtains a first data packet, provides it to unpackager 212, and receives the unpackaged and joined data back from unpackager 212.Unpacker and joiner 212 stores all received packets and joins them together. It can receive packets out of sequence, receive multiple streams (from different content providers or the same content provider). In sum, the unpackager 212 implements a simple file system where a file comprises the complete data which was sent, before packetization.

The file name is formed of the IP address which is that of the service provider, along with the sequence number which, in addition to indicating a packet stream sequence member, indicates whether this particular packet is the last packet in a sequence being transmitted. The packets are received and stored in an ordered, linked list by unpackager and joiner 212.

Radio receiver and driver 22 receives and buffers

a complete page of information. It then passes this page to message router 210 which writes the page to a file. Router 210 then calls unpackager and joiner 212. The packet is appended to a file whose name is derived from the IP address and sequence number combination contained in the given packet. If the file does not yet exist, then it is created new by unpackager 212.

When the packet marked as last packet is received, then unpackager 212 knows how many packets to expect. Recall that the last packet need not arrive temporally last. Unpackager 212 counts the number of packets already received and stores the number of packets it expects in a counter. Each time a non-duplicate packet is appended, the counter is decremented. When it falls to zero, all packets have been received. The unpackager 212 then marches through the index file which it has created, and which contains a time stamp indicative of the order of the packets received. The unpackager creates a data file in correct sequence and passes the data file on for further processing.

As soon as all packets have arrived, the data file containing the ordered linked list is removed from the file system in unpackager 212 and is passed either on to additional translators in translation layer 209 or back to router 210.

In order to deal with lost, duplicate, and erroneous packets, a checksum error detection method using cyclic redundancy code-32 (CRC-32) method is implemented over the entire file of data bytes (i.e., it excludes all header bytes).

In order to detect lost packets, the time stamp

of the last packet received in the index file is recorded. Unpackager 212 checks this time stamp each time it processes a packet for the present data file, or for any other data file. If the time difference between a current time and the time of the last packet received is over a desired number of minutes (or any other suitable time interval), it is assumed that any remaining packets for the data file have been lost and the data file is deleted.

Duplicate packets are detected by referencing the index file which will already have an initialized entry for that packet. Two options can be implemented in dealing with duplicate packets. First, the new packet can be discarded and the old one retained. Second, the new packet can be appended to the data file by overwriting the index entry for the first (or old) packet. This will have the effect of discarding the old packet.

In any case, to conclude the example provided in FIG. 8, once the packets have been unpacked and joined, router 210 examines the headers on the data to find that the data must first be provided to decoder 266. Decoder 266 decodes the data and provides it back to router 210. The next header on the data is examined by router 210 and indicates that the data needs to be provided to decrypter 268. Decrypter 268 decrypts the data and then returns it to router 210. Router 210 then provides the data to decompressor 270, based on the header information remaining with the decrypted data. Decompressor 270 decompresses the data and either returns it to router 210 or provides it to router component 216 which identifies the particular destination for the data. In the preferred

embodiment, routing component 216 is coupled to web content cache 208 and e-mail inbox 272. Of course, other destinations can also be provided.

One specific implementation of a translator, along with a more detailed description of illustrative compression, encryption and encoding translators is provided in the above-referenced co-pending U.S. patent applications, which are hereby fully incorporated by reference, as well as Appendix A hereto.

Thus, by separating the content into separate script template and data files, the present invention provides the ability to deliver content to a mobile device over a low bit rate channel in an economic and efficient manner. Small segments of data can be delivered instead of full HTML pages. The present invention also provides a mechanism by which logging and filtering can be accomplished in an efficient manner.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

Appendix

Mobile Channels Scripting Environment

The Mobile Channels scripting model is based on Active Server Pages (ASP), as defined in IIS. ASP code is written in VBS. In Mobile Channels, both ASP and VBS are scaled down to fit the constraints of Windows CE devices. The streamlined ASP is also known as pocket ASP (pASP). Together, pASP and VBS are referred to as the Mobile Channels scripting environment. The discussions presented here focus on the differences between pASP/VBS for Mobile Channels and ASP/VBS for Active Channels.

Types

There are three legal data types for Mobile Channels scripting: STRING, NUMERIC, and BOOLEAN. However, only STRING is supported internally. The other two are derived from STRING. String literals may be specified using the double quote character (") to bracket the expression. Numeric strings may be specified without quotes. Numbers can be of integers only and their values range between -32,768 and 32767. Boolean expressions evaluate to 1 for true and 0 for false. They may not be assigned to TRUE or FALSE as in Visual Basic. For example,

Data Type	Value	Description
STRING	*"Example string literal"*	
NUMERIC	`Result=3+4`	The result evaluates to 7. But *Result* is stored as a string value.

BOOLEAN	(a) 3 = 3, (b) 3 = 5	(a) evaluates to 1 and (b) to 0.

Data Structures

Mobile Channels supports the following data structures.

Data Structure	Description
Variable	Elemental data structure of the simple data types presented above. Variable names are alphanumeric and must start with an alpha character. The underscore character can be used except for the leading character. Variable names should be short to conserve memory and can not be longer than 255 characters in any case.
Array	An ordered collections with numeric keys. The index counts from zero (0). For example, `Result = a(0)+a(1).` The method, **Array.Count** returns the total number of elements in the array.

Keywords

The following keywords are reserved and may not be used as variable names:

If, Then, Else, ElseIf, End If
For, Next, Do While, Loop, Exit For, Exit While
Set, Response, Request, MobileChannels
Now, LocDate, Len, Mid, Split, Asc, Chr, StrComp, Random

Comments

Comments are started with the single quote (') and may appear anywhere on a line. **REM** of VBS is not supported for Mobile Channels scripting. The following is an example of a comment.

```
' this is an example comment.
```

Appendix

Operators and Precedence

Operator	Type	Precedence	Description
*	Numeric	1	Multiplication
/	Numeric	1	Division
Mod	Numeric	1	Modulo division
+	Numeric	2	Addition
-	Numeric	2	Subtraction
&	String	2	Concatenation
<	Boolean	3	Less than
<=	Boolean	3	Less than or equal to
>	Boolean	3	Greater than
>=	Boolean	3	Greater than or equal to
=	Boolean	3	Equal to
<>	Boolean	6	Not equal to
And	Boolean	4	Logical AND
Or	Boolean	4	Logical OR
Not	Boolean	5	Logical NOT

Expressions are evaluated according to operator precedence. Operators of higher precedence (1 being the highest) get evaluated first. Operators of the same level are evaluated from left to right. Precedence may be overridden using parenthesis which can be nested. The inner most parenthesis is evaluated first.

Unlike in VBS, all expressions within a statement are always evaluated. In the following example, if *arr.count* is not greater than zero, *arr(1)* and *arr(2)* will be evaluated and the references to *arr(j)* will result in error.

```
If arr.count >0 and arr(1) = "foo" then
   arr(2) = "bar"
End If
```

If the first logical expression is false, the ensuing expressions are invalid. The correct implementation should be as follows.

```
If arr.count > 0 then
   If arr(1) = "foo" then
      arr(2) = "bar"
```

```
   End If
End If
```

Escaping Special Characters

Special characters such as the double quote may be "escaped" within a string literal by preceding it with the back slash character (\). The back slash character can be included in a string by escaping it as well. For example,

```
"This is a string that contains \" double quoates\"."
"This is a string that contains back slashes as in a file path:
\\c:\\windows."
```

Statements

In the Mobile Channels scripting environment, there are five classes of statements:

Assignment

The assignment statement is of the following form:

```
<variable> = <expression>
```

Conditional

The **If** statement provides conditional flow of control. The **End If** part is required. The statements after a logical expression will not be evaluated unless the logical expression evaluates to true (1). The conditional statement can be one of the following forms:

```
If <logical expression> Then
      <statement>
End If
```

or

```
If <logical expression> Then
      <statement1>
Else
      <statement2>
End If
```

or

```
If <logical expression1> Then
      <statement1>
```

Appendix

```
ElseIf <logical expression2> Then
      <statement2>
End If
```

Or

```
If <logical expression1> Then
      <statement1>
ElseIf <logical expression2> Then
      <statement2>
Else
      <statement3>
End If
```

Loop

There are two types of loop statements: **For/Next** and **Do/While**:

The **For** loop iterates through the loop by setting the *variable* initially at numeric *expression1* and incrementing this value by the **Step** amount (*expression 3*) with each pass through the loop. When the optional **Step** clause is omitted, the default clause of **Step** 1 is invoked. The loop terminates when the variable reaches a value greater than *expression2*.

```
For <variable>=<expression1> To <expression2> [Step <expression3>]
     <statements1>
     (Exit For)    ' Optional
     <statements2>
Next
```

The **Do While** loop continues looping until the logical expression, *logExpression* becomes false (0). The **Exit** statements provides a way to terminate a loop without satisfying the normal termination criteria. When **Exit** is encountered, the loop breaks and execution resumes at the statement immediately following the loop. **Exit** is usually used in conjunction with a conditional statement.

```
Do While <logExpression>
     <statements1>
     (Exit While)  'Optional
     <statements2>
Loop
```

Active Server

Appendix

Active Server statements refer to the methods of pASP objects such as **Response** and **Request**. The **Response.Write** statement returns an output to the HTML stream. For example,

```
Response.Write("<A Href=MCTP://MSNBC/ch2> Click here to jump to
Sports </A>").
```

The Mobile Channels scripting environment exposes certain server variables. The **Request.ServerVariables** statement may be used to query the server variables. It takes a name string expression and returns a value string expression associated with the name. So

```
newURL=Request.ServerVariables("URL")
```

obtains the root URL for the channel of the page. And

```
platStr=Request.ServerVariables("Platform")
```

returns the platform string as one of the following:

String	Platform
"WIN32_CE"	Windows CE
"WIN32_WINDOWS"	Windows 95/Windows 98
"WIN32_NT"	Windows NT

Similarly, the **Request.QueryString** statement returns the value of a specified argument passed to the page as part of the URL. For example, if URL for a page is named as "*MCTP://msnbc/ch2 ? city=seattle*", then the statement

```
theCity = Request.QueryString("city")
```

assigns *Seattle* to the *theCity* variable.

Set

The **Set** statement assigns a variable to an instance of an object. However, the Mobile Channels scripting environment supports only the **MobileChannels.Utilities** pseudo object. Thus the only usage of the **Set** statement is to create an **MobileChannels.Utilities** object and assigns it to an instance variable:

Appendix

```
Set mc_variable = Server.Create("MobileChannels.Utilities")
```

Line breaks are ignored when a statement is evaluated. Thus, statements can wrap to more than one line. The statement continuation character ("_") is recommended, but not mandatory. For example,

```
MyVar = "This is an example of " & _
        "a statement appearing " &
        "on multiple lines." & MyVar
```

Functions

The following functions are exposed in the Mobile Channels scripting environment.

Now
Returns the current date and time and takes no argument. For example,
`Response.Write("Today's date is " & Now).`

LocDate
Returns the date using the current regional settings to format the date. For example,

```
Response.Write( "Date: " & LocDate )
```

Len(*<string>*)
Returns the length of a string. For example
`Len("Hello?")`

returns 6.
Mid(*aStringExpression, startNumExpression,[length]*)
Returns a sub-string of an existing string. The resulting sub-string is of *length* characters long and begins at the *Start* character number (counting from one, not zero) in the original *string* expression. For example,

```
Foo = Mid("This is my String", 9, 2).
```

Foo is now set to "*my*".
Split(*aStringExpression, delimiterStringExpression*)

Appendix

Parses a string into sub-strings based on a specified delimiter. The result is returned as an array of strings. For example,

```
Names = Split("Bob;Fred;Joe;",";")
```

results in the following sub-strings:

```
Names(0)="Bob"
Names(1)="Fred"
Names(2)="Joe"
Names(3)=""
```

Asc(*aStringExpression*)
Converts a character string into its numeric ASCII value and returns an numeric expression. If the *aStringExpression* is longer than one character, the function returns the ASCII value of the first character only.

Chr(*numericExpression*)
Converts an ASCII numeric value to the associated character and returns a string expression of one character long. For example, to create a string containing one newline character, use,

```
str = Chr(10)
```

StrComp(*S1*, *S2* [,*Compare*])
This function compares two strings, *S1 and S2*, optionally specifying the comparison mode, *Compare*. The *Compare* argument can be 0 or 1. If *Compare* is omitted, a binary comparison is performed.

This function returns one of the following values:

Condition	Return Value
S1 is less than *S2*	-1
S1 is equal to *S2*	0
S1 is greater than *S2*	1

Random(*range*)
The function generates a random number in the range 0 to one less than *range*. For example,

```
num = Random(10)
```

generates random numbers from 0 to 9 inclusive.

Mobile Channels Scripting Object

MobileChannels.Utilities is a pseudo object in the Mobile Channels scripting environment that provides support for navigation and manipulation of objects within a CDF file. The **Utilities** object provides a number of methods for Mobile Channels scripting. These methods are summarized in the following table.

Methods	Description
Data	Reads a block of data from a data item
Debug	Emits debug output to aid script development
Href	Returns an element's HREF
HrefExists	Returns true if an item exists in cache
IsSubscribed	Returns subscribed state of a channel/subchannel
IsUnread	Returns read/unread state of item or channel/subchannel
LibraryCall	Accesses a DLL special function
Locate	Jump to a specified ID within the CDF
Navigate	Traverses a CDF file
Tag	Returns the tag of an element in a CDF file
Title	Returns an element's title
Value	Returns the value of an element in a CDF file

To use these services, the **Utilities** object must be instantiated first using the **Set** function as follows:

```
Set MC = Server.Create("MobileChannels.Utilities")
```

MC will be used below as a shorthand for the **MobileChannels.Utilities** scripting object, however, the object may be assigned to any variable name.

Navigate Method of the Utilities Objects

The **MC.Navigate()** command is a powerful, frequently used, and by far the most important method in pASP. It is designed to help examine the structure of a

mobile channel, as represented in CDF, at run time. To understand the behavior of this command, a brief discussion of the background and terminology is helpful.

The basic operand of the **Navigate** command is an element that is the smallest unit of information in a CDF file. Every element has a *tag* and optionally a *value*. The **MC.Tag()** and **MC.Value()** methods of pASP may be used to fetch these strings for any element. The elements are organized into a tree structure as specified by XML as the CDF file is parsed. The **Navigate** command lets us move to specific elements within the tree, and to move between elements with certain relationships. This information can be very useful to the channel scripts which use CDF to dynamically generate the HTML pages for the channel at run time.

The discussions below will refer frequently to the sample CDF file and its associated parse tree, which are provided at the end of this document. The parse tree shows the internal representation of the sample CDF file. Each line of the parse tree is equivalent to an element, and all start with the tag for the element. The more indented elements are children of their less indented parents. Elements at the same level of indentation are siblings. In the CDF file, for example, the **BASE** element is a child of the top-level **CHANNEL** element. The first **HREF** element is a sibling of the **BASE** element. The **INTERVALTIME** element is a child of the **SCHEDULE** element.

Many elements are considered to have a default value. These are indicated in the parse tree by an "= [*string*]" expression following the tag of the element. The default value is determined in the following scheme. First, if the element under consideration has a string directly associated with it, the string is the default value. Next, if there is a child **VALUE** element, the child's value becomes the default one. If no **VALUE** element is provided, but a child **HREF** element is found, its value becomes the default value. If none of these can be found, the **VALUE** is empty. For example, the value of the first **ID** tag is a direct string, the **TITLE** tag has an explicit **VALUE** element, so this is used, and the value of first **LOGO** tag

is its **HREF**. The **SCHEDULE** tag has no direct string, **VALUE** or **HREF** children, so its value is empty.

The **Navigate** function has the following syntax:

```
NewElem = MC.Navigate( StartElem, NavAction, [,Match] )
```

The function returns a new element, or 0 if the command could not find the specified element. You may test this return value using standard VBS comparisons such as:

```
IF NOT NewElem THEN
   ' not found
END IF
```

The *StartElem* parameter is the starting element from which to base relative movement commands. If you are using the absolute movement command "*Jump*", you must use "" for the *StartElem* parameter. But in all other cases it must be a valid element returned from a previous **Navigate()** command.

The *NavAction* parameter must be one of the following strings:

"*Jump*"
The "*Jump*" action is the first command used to get a starting element. It is equivalent to the **MC.Locate()** command (see below). The *StartElem* parameter must be an empty string. The "*Jump*" action navigates directly to a specific element in the CDF as identified by the supplied ID. For example, the following statement,

```
NewElem = MC.Navigate( "", "Jump", "D1" )
```

jumps to the first data item element in the example CDF file. The *NewElem* will be the **ITEM** parent element to the **ID** element ("D1", about halfway down in the example CDF file).

"*First*"
The "*First*" action moves to the first element at a given level. For example, from the **ID** element of the first **LOGO** element in the example CDF file, a

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"*First*" action will move to the **STYLE** tag of that **LOGO**. More practical scenarios are to use this action to go back to the beginning of the list of **ITEM**s under a subchannel.

```
NewElem = MC.Navigate( StartElem, "First" )
```

"*Out*"

The "*Out*" action moves to the parent element from the current element, or to the left one indent in the parse tree diagram. For example, from the **TITLE** element of the example CDF, the "*Out*" action will result in the movement to the top-level channel element.

```
NewElem = MC.Navigate( StartElem, "Out" )
```

"*In*"

The "*In*" action moves to first child element beneath the current element. For example, from the first **USAGE** element in the example CDFfile, the "*In*" action will result in a movement to the **VALUE** element.

```
NewElem = MC.Navigate( StartElem, "In" )
```

"*Prev*"

The "*Prev*" action moves to the element at the same level immediately previous to the current element. If it does not find a previous element at the same level, it will return 0; it will not next out to the parent element. For example, if from the **BASE** element in the example CDF file, the "*Prev*" action will result in a move to the HREF element right before it. Calling "Prev" again will return 0 since there are no more siblings at this level.

```
NewElem = MC.Navigate( StartElem, "Prev" )
```

"*Next*"

The "*Next*" action moves to the next element at the same level. As with the "*Prev*" action, if it finds no such sibling element, it returns zero. For example, from the first **LOGO** tag in the example CDF file, the "*Next*" action will result in a move to the second **LOGO** element.

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```
NewElem = MC.Navigate( StartElem, "Next" )
```

"*Match*"

The "*Match*" action attempts to find a sibling element with a tag matching the specified match string. It will traverse as many siblings as it needs to until it either finds a match or can find no more siblings. If the "*Match*" action starts from a matched element, it will simply return the current element. To match beyond the current element, the "*Match*" action must follow a "*Next*" action.

```
NewElem = MC.Navigate( StartElem, "Match", "TagToMatch" )
```

"*InMatch*"

The "*InMatch*" action is the same as "*Match*" above except it begins its search at the first child of the current element. This can be useful for looking for specific subtags which modify the enclosing element. For example, the following statements,

```
UsageElem = MC.Navigate( StartElem, "InMatch", "USAGE" )
If UsageElem Then
   Usageval = MC.Val( UsageElem )
   ' test for specific usage...
End If
```

look for the **USAGE** tag for a specific item.

The only actions that use the optional third parameter are "*Match*" and "*InMatch*".

Other Methods of the Utilities Object

Tag

This method returns the tag name of an element:

```
tagString=MC.Tag(elementID)
```

Value

This method returns the value of an element:

```
valString=MC.Value(elementID)
```

Data

This method gets data from a Mobile Channels data file and returns an array of name-value pairs based on the current location and the specified block number.

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The names are the field names as specified in an **ITEMFORMAT** statement and the values are the data items (lines) as fetched from the data file. In the following example, *dataItems* is an array to hold the data items,

```
dataItems =MC.Data(elementID, blockNum)
```

where *elementID* is the current location within the CDF file, for example, the **ID** item for the MCD file, and *blockNum* is the block number within the file. Blocks start with zero. So the first repeating block, if present, is always block number one (even if there is no header). The resultant array, *dataItems*, contains an element for each item (line) within the block. The items in a block counts from zero.

Each data item is, in effect, an object that supports the **Tag**, **Type**, and **Value** methods to expose its own properties.

Tag

dataItems(index).Tag returns the field name for the indexed array position, as declared in the **<ITEMFORMAT>** element.

Value

dataItems(index).Value returns the value of the field for the indexed array position.

Type

dataItems(index).Type returns the type as specified in the **<ITEMFORMAT>** statement. If no type is listed or if the **<ITEMFORMAT>** tag is missing, then the **Type** method returns "HTML". Other types include "TEXT", "IMG", and "HREF".

Type	Description
HTML	The line item is HTML formatted content. This is the default type.
HREF	The line is a URL, (either http:// or mctp://).
IMG	The line contains the ID of an image item in the CDF file.
TEXT	Same as HTML.

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Locate

The function is of the following form:

```
newElem = MC.Locate("ID")
```

and is a shorthand for the "*Jump*" action of the **Navigate** method:

```
newElem = MC.Navigate( "", "Jump", "ID" )
```

LibraryCall

This function allows a script to access a custom DLL to perform functions not available through standard scripting. The method is of the following form:

```
Result = MC.LibraryCall( LibName, FuncName [,param]* )
```

First, the method checks for security to verify that the DLL has been properly registered for access via pASP scripting. An accessible DLL must have a registry entry in **\HKLM\Software\Microsoft\Mobile Channels\Components**, matching the name of the DLL.

Then the **LibraryCall** method dynamically loads the specified DLL by calling the **GetProcAddress** function to look up the specified function. Any additional parameters are then marshalled before being forwarded to the DLL function. Up to 8 optional parameters may be passed.

The DLL function must return a LPWSTR value. If the return value is NULL, **LibraryCall** returns zero (0). Otherwise, it returns the string itself as a standard pVBS string value.

Debug(*Mesg*)

The **Debug** method allows a debug string to be written out during the execution of the script. This may be useful during development to help examine program flow. The debug messages will appear in the console window of any attached debugger, similar to the **OutputDebugString** API.

The function does not return any value.

HrefExists(*Href*)

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This method tests to determine whether the specified URL can be found in cache. This allows a script to gracefully handle missing images, data elements, or other components needed by the script. The URL must be a fully qualified http-style URL.

This method returns 1 if found in cache, else 0.

Href(*Elem*)

This method returns the full URL for the specified element if it is specified in the CDF file. It returns 0 if no URL can be found.

IsSubscribed(*ChanElem*)

This tests to see if the specified channel or subchannel element is currently subscribed to by the user. It returns 1 if the channel is subscribed, or 0 if it is not found or not subscribed.

Note: this will not work on items, only on channels. Furthermore, it always returns 1 when running on the desktop (in IE4).

Title

This method is of the following form:

```
titleString = MC.Title( ElemString )
```

and it attempts to decipher the title of a given element by the following means:

If there is an explicit **TITLE** tag for this element, the value of that is returned,

If it is an *.mcd* data item with an **ITEMFORMAT** specifying a **TITLE** field, the data item is opened and the title extracted therefrom,

If an **ID** element is provided, its value is returned,

If anything else, NULL is returned.

Note that this method does not mark a data item as "Read" as it fetches the title. This is different from using **Navigate** to get the title. The latter method marks the item as "Read", even if the user has not actually looked at it.

IsUnread

This method returns a boolean indicating whether the associated item or channel has been read.

```
newContent = MC.IsUnread( Elem )
```

The function returns non-zero value if called directly on an unread item. When called on a subchannel, it will return non-zero if any items *or other subchannels* within the subchannel have not been read.

SetUnread

This method sets the read/unread state for an item and returns no value. And it is of the following format.

```
SetUnread(Elem [,Flag])
```

The *Elem* parameter should be a valid element from a prior **Navigate()** or **Locate()** call. The optional *Flag* parameter is a boolean used to mark the state of *Elem*: 0 for "unread" and 1 for "read". The default value of *Flag* is "unread".

Note Due to a limitation of the version 1.0 implementation of Mobile Channels, image items do not get marked as "read" automatially (as do MDC items). This results in the image remaining marked as "unread" even though it has been read. Further, all the parent subchannels will also show as "unread" as long as any images within are unread. To remedy this situation, the script author should manually mark each image as "unread" each time it is displayed. The **SetUnread()** utility is the correct way to achieve this.

Channel Browser and Active Desktop HTML Extensions

Several HTML extensions provide additional functionality for writing more advanced scripts for Active Desktop and for controlling page updates in Channel Browser.

Appendix

Application Links

Windows CE Active Desktop supports a special HTML Href for launching an application from a hyperlink. The format is:

```
<A HREF="mcexe://[appname]">Launch Text</A>
```

appname is the name of the application to be launched when the link is clicked.

The application must have been registered by placing a value of the same name as the **.exe** in the registry at **\HKLM\Software\Microsoft\Mobile Channels\Components**.

META Tags

Channel Browser and Active Desktop recognize the following special META tags. Embedding these META tags in the header of a page, either directly or via scripting can cause the page to be automatically handled or updated in a particular manner. Note that these META tags (with the exception of *Refresh*) are ignored by IE4.

The META tags are summarized in the following table.

Http_Equiv	Description	Support
Notify	Catch cache or database updates	Active Desktop and Channel Browser.
Refresh	Reload after time interval	Active Desktop
LaunchApp	Execute application for desktop component	Active Desktop
Autosize	Control image scaling	Channel Browser

The following are some detailed discussions of each tag.

Notify

This META tag allows a page to be automatically updated when there is an update to a particular database, or when a particular item is updated in cache. This can be used to regenerate a page automatically when a new version of it (or one of its components) comes in via sync or other mechanism. The two forms of this META tag are:

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```
<META HTTP-EQUIV="Notify"
      CONTENT="DBUPDATE=[DBname];URL=[RefreshUrl]">
<META HTTP-EQUIV="Notify"
      CONTENT="CACHEUPDATE=[WatchUrl];URL=[RefreshUrl]">
```

DBname is the name of the database to monitor for updates.
WatchUrl is the URL of an item to watch for cache updates on.
RefreshUrl is the URL to load if an update is detected.

Refresh

This META tag causes a page to be automatically reloaded after a specified time interval. The form is:

```
<META HTTP-EQUIV="Refresh" CONTENT="[secs];URL=[RefreshUrl]">
```

secs sets the number of seconds until the page will be reloaded.
RefreshUrl is the URL to load after the specified interval.

LaunchApp

This META tag allows an application to be launched by clicking on the header of an Active Desktop component on the device. The form is:

```
<META HTTP-EQUIV="LaunchApp" CONTENT="[appname][?params]">
```

appname is the name of the executable to launch.
params is an optional comma separated list of *params* to be passed to the application upon invocation

The application must have been registered by placing a value of the same name as the **.exe** in the registry in **\HKLM\Software\Microsoft\Mobile Channels\Components**.

Autosize

This META tag allows the default image scaling behavior to be disabled for a particular page. The HTML control will, by default, attempt to scale images for display on the smaller form factor screen. However, if this META is specified in the page header the images will displayed at the full size causing scrollbars to appear if needed. The form is:

```
<META HTTP-EQUIV="Autosize" CONTENT="Off">
```

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Note that since the default value is always "On" there is no need for any other value in the CONTENT field.

Example CDF File

```
<?XML version="1.0"?>
<CHANNEL
    HREF="mctp://mySite/34droad/34droad.cdf "
    BASE="http://mySite/" ID="34droad">
    <SELF HREF="http://mySite/34droad/34droad.cdf" />
    <SCHEDULE><INTERVALTIME MIN="40"/></SCHEDULE>
    <USAGE VALUE="MobileChannel"/>
    <TITLE>3 4 D Road</>
    <ABSTRACT>Things to think about while you're away...</>
    <LOGO STYLE="IMAGE" HREF="34droad/34logo.gif" ID="LOGO"/>
    <LOGO STYLE="ICON"  HREF="34droad/34icon.gif" ID="ICON"/>
    <CHANSCRIPT VALUE="SS"/>
    <ITEMSCRIPT VALUE="SS"/>
    <ITEM HREF="34droad/34.mcs" ID="SS">
        <ABSTRACT>Things to think about while you're away...</>
    </ITEM>
    <ITEM HREF="cgi-bin/deep1.mcd?1" ID="D1">
        <USAGE VALUE="MobileChannel"/>
        <LOG VALUE="document:view"/>
    </ITEM>
    <ITEM HREF="cgi-bin/deep1.mcd?2" ID="D2">
        <USAGE VALUE="MobileChannel"/>
        <LOG VALUE="document:view"/>
    </ITEM>
    <ITEM HREF="cgi-bin/deep1.mcd?3" ID="D3">
        <USAGE VALUE="MobileChannel"/>
        <LOG VALUE="document:view"/>
    </ITEM>
    <ITEM HREF="34droad/34logo.gif" ID="LOGO">
        <USAGE VALUE="None"/>
    </ITEM>
    <ITEM HREF="34droad/34icon.gif" ID="ICON">
        <USAGE VALUE="None"/>
    </ITEM>
    <ITEM HREF="34droad/34main.gif" ID="MGIF">
        <USAGE VALUE="None"/>
        <LOG VALUE="document:view"/>
    </ITEM>
</CHANNEL>
```

Appendix

Parse Tree of the example CDF file

```
CHANNEL = mctp://mySite/34droad/34droad.cdf
    HREF = mctp://mySite/34droad/34droad.cdf
    BASE = http://mySite/
    ID = 34droad
    SELF = http://mySite/34droad/34droad.cdf
        HREF = http://mySite/34droad/34droad.cdf
    SCHEDULE
        INTERVALTIME
            MIN = 40
    USAGE = MobileChannel
        VALUE = MobileChannel
    TITLE = 3 4 D Road
        VALUE = 3 4 D Road
    ABSTRACT = Things to think about while you're away...
        VALUE = Things to think about while you're away...
    LOGO = 34droad/34logo.gif
        STYLE = IMAGE
        HREF = 34droad/34logo.gif
        ID = LOGO
    LOGO = 34droad/34icon.gif
        STYLE = ICON
        HREF = 34droad/34icon.gif
        ID = ICON
    CHANSCRIPT = SS
        VALUE = SS
    ITEMSCRIPT = SS
        VALUE = SS
    ITEM = 34droad/34.mcs
        HREF = 34droad/34.mcs
        ID = SS
        ABSTRACT = Things to think about while you're away...
            VALUE = Things to think about while you're away...
    ITEM = cgi-bin/deep1.mcd?1
        HREF = cgi-bin/deep1.mcd?1
        ID = D1
        USAGE = MobileChannel
            VALUE = MobileChannel
        LOG = document:view
            VALUE = document:view
    ITEM = cgi-bin/deep1.mcd?2
        HREF = cgi-bin/deep1.mcd?2
        ID = D2
        USAGE = MobileChannel
            VALUE = MobileChannel
        LOG = document:view
            VALUE = document:view
    ITEM = cgi-bin/deep1.mcd?3
```

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```
    HREF = cgi-bin/deepl.mcd?3
    ID = D3
    USAGE = MobileChannel
        VALUE = MobileChannel
    LOG = document:view
        VALUE = document:view
ITEM = 34droad/34logo.gif
    HREF = 34droad/34logo.gif
    ID = LOGO
    USAGE = None
        VALUE = None
ITEM = 34droad/34icon.gif
    HREF = 34droad/34icon.gif
    ID = ICON
    USAGE = None
        VALUE = None
ITEM = 34droad/34main.gif
    HREF = 34droad/34main.gif
    ID = MGIF
    USAGE = None
        VALUE = None
    LOG = document:view
        VALUE = document:view
```

WHAT IS CLAIMED IS:

1. A system for providing information content from a content provider to a mobile device, comprising:

a provider component including:

a first store storing the content as a data file and a corresponding script file, the data file including data indicative of the content to be rendered and the script file including a script indicative of a desired rendering form in which the data is to be rendered, wherein the script file and the data file are transmittable independently of one another;

a transmitter coupleable to the first data store and configured to transmit the content to the mobile device; and

a mobile device component, disposed on the mobile device, including:

a receiver configured to receive the content from the transmitter;

a second store;

a router coupled to the receiver and the second store and configured to provide the script

file and the data file to the second store; and

a transport coupled to the second store and configured to selectively retrieve the data file and execute the script to place the data in the desired rendering form.

2. The system of claim 1 wherein the provider component comprises:

a first translator layer coupled to the first store and configured to retrieve the data file and the script file and translate the data and script form an untranslated form to a translated form.

3. The system of claim 2 wherein the mobile device component comprises:

a second translator layer coupled to the receiver and configured to translate the data and script from the translated form to the untranslated form.

4. The system of claim 3 wherein the first translator layer comprises a compressor configured to compress the data and script from an uncompressed form to a compressed form and wherein the second translator layer comprises a decompressor coupled to the receiver and configured to decompress the data and script from the compressed form the the decompressed form.

5. The system of claim 3 wherein the first translator layer comprises an encryptor configured to encrypt the script and data and wherein the second translator layer comprises a decryptor configured to decrypt the data and the script.

6. The system of claim 3 wherein the first translator layer comprises an encoder configured to encode the script and data and wherein the second translator layer comprises a decoder configured to decode the script and data.

7. The system of claim 3 wherein the first translation layer comprises a packager configured to divide the script and data into portions and translate the portions into packets suitable for transmission and wherein the second

translation layer comprises an unpackager configured to untranslate and assemble the packets.

8. The system of claim 3 wherein the first translator layer is configured to provide tag information indicative of translation operations performed on the script and data and to provide the tag information along with the script and data in the translated form and wherein the second translator layer is configured to perform translation operations on the script and data based on the tag information.

9. The system of claim 1 wherein the transmitter comprises:

a wireless transmitter for transmitting the content over a wireless transmission link and wherein the receiver comprises a wireless receiver configured to receive the content over the wireless transmission link.

10. The system of claim 1 and further comprising:

a desktop computer selectively coupleable to the provider component and including a retrieval

component configured to retrieve the data file and the script file, the transmitter comprising a synchronization component on the desktop computer configured to be selectively coupleable to the mobile device.

11. The system of claim 10 wherein the receiver comprises:

a synchronization component on the mobile device selectively coupleable to the synchronization component on the desktop computer, wherein the synchronization component on the desktop computer and the synchronization component on the mobile device are configured to selectively synchronize the script file and the data file to the mobile device.

12. The system of claim 11 wherein the first store includes a definition file describing characteristics of the information content including a logging characteristic and wherein the transport logs rendering information indicative of rendering of the information content on the mobile device.

13. The system of claim 12 wherein the synchronization component on the mobile device is configured to synchronize the rendering information to the desktop computer and wherein the retrieval component is configured to provide the rendering information to the provider component.

14. The system of claim 13 wherein the rendering information includes a rendering count indicative of a number of times the information content is rendered on the mobile device and a rendering duration indicative of a duration for which the information content is rendered on the mobile device.

15. The system of claim 10 wherein the provider component further comprises:

a wireless transmitter for transmitting the content over a wireless transmission link and wherein the receiver further comprises a wireless receiver configured to receive the content over the wireless transmission link.

16. The system of claim 1 wherein the information content comprises information rendered using a processor-independent language.

17. The system of claim 16 wherein the information content comprises information rendered using hypertext markup language (HTML).

18. The system of claim 3 wherein the first translation layer provides the script and data, in the translated form, with a plurality of separate filtering segments, the receiver on the mobile device selectively receiving and discarding the script and data based on a first of the plurality of filtering segments, and the second translation layer selectively receiving and discarding the script and data based on a second of the plurality of filtering segments.

19. The system of claim 18 wherein the information content comprises group information and topic information on a subscribable channel, wherein the second of the plurality of filtering segments includes a first filtering portion corresponding to the group information and a second

filtering portion corresponding to the topic information and wherein the second translation layer filters based on the group and topic filtering portions independently of one another.

20. A computer readable medium including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

intermittently receiving a data file and a corresponding script file, the data file including data indicative of the information and the script file including script information indicative of a desired form in which the data is to be rendered, the data file and corresponding script file being independently receivable by the mobile device;

storing the script file and data file; and

retrieving the data from the data file and executing the script in the corresponding script file to render the data.

21. The computer readable medium of claim 20 including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

intermittently receiving an updated data file including updated data; and

executing the script in the corresponding script file, already stored on the mobile device, to render the updated data.

22. The computer readable medium of claim 21 wherein the step of executing the script in the corresponding script file, already on the mobile device, is performed in response to receiving the updated data.

23. The computer readable medium of claim 22 wherein executing the script comprises:

rendering the data in a processor independent form.

24. The computer readable medium of claim 23 wherein executing the script comprises:

rendering the data in hypertext markup language (HTML) form.

25. The computer readable medium of claim 20 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by perform steps comprising:

intermittently receiving an updated script file including updated script; and

executing the updated script on data in the corresponding data file, already stored on the mobile device, to render the data according to the updated script.

26. The computer readable medium of claim 21 wherein the data file and corresponding script file are received in a translated form and further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

untranslating the data file and script file into an untranslated form.

27. The computer readable medium of claim 20 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

intermittently receiving additional script files including additional script; and

intermittently receiving additional data files, corresponding to the additional script files and including additional data.

28. The computer readable medium of claim 27 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

executing the additional script in the additional script files on data in the corresponding additional data files to render the additional data according to the additional script.

29. The computer readable medium of claim 20 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

logging rendering data based on rendering of the information.

30. The computer readable medium of claim 29 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

synchronizing the rendering data to a desktop computer.

31. The computer readable medium of claim 20 further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

receiving the script file and data file with a plurality of separate filtering segments; and

selectively receiving and discarding the script and data based on the plurality of filtering segments.

32. The computer readable medium of claim 31 wherein the information content comprises group information and topic

information on a subscribable channel, and further including instructions readable by a mobile device which, when implemented, cause the mobile device to handle information by performing steps comprising:

selectively receiving and discarding the script and data based on a first filtering portion corresponding to the group information and a second filtering portion corresponding to the topic information, wherein the filtering is based on the group and topic filtering portions independently of one another.

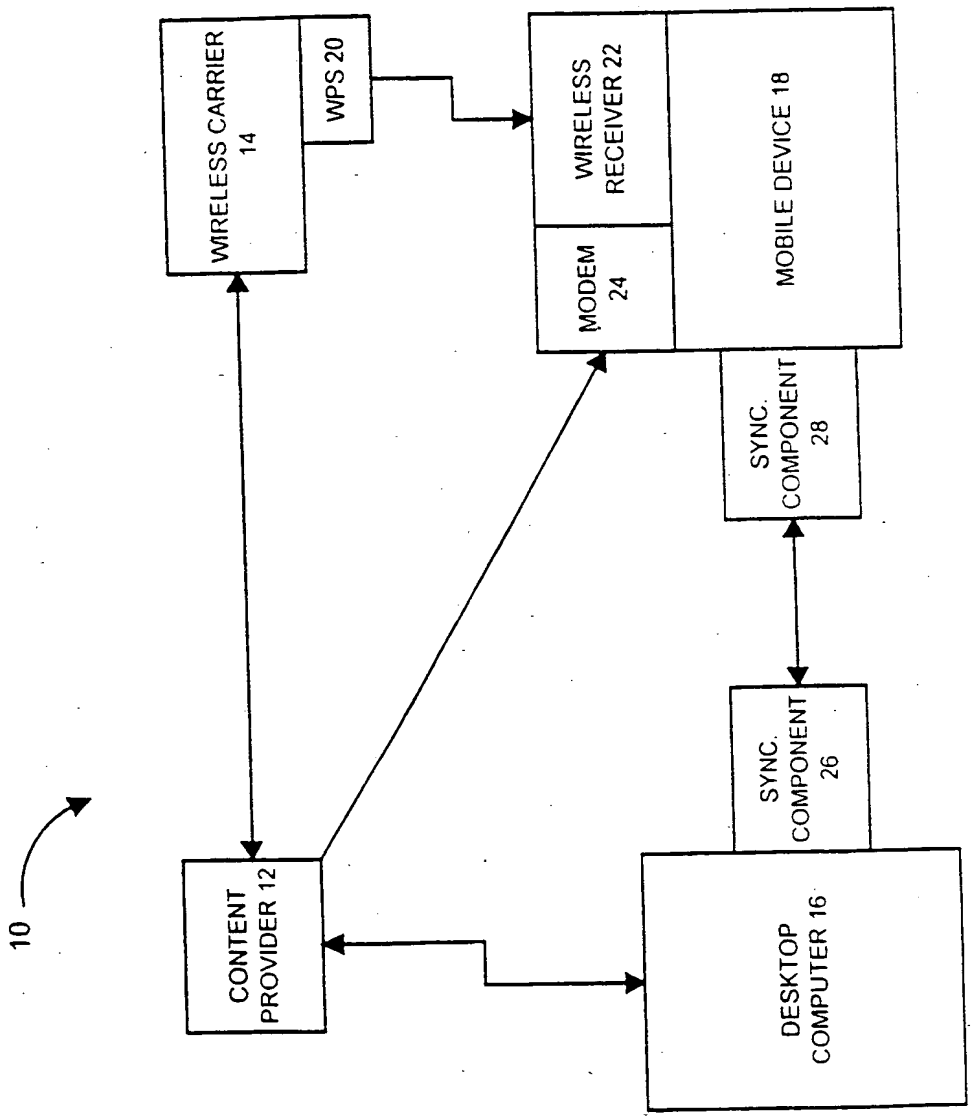


FIG. 1

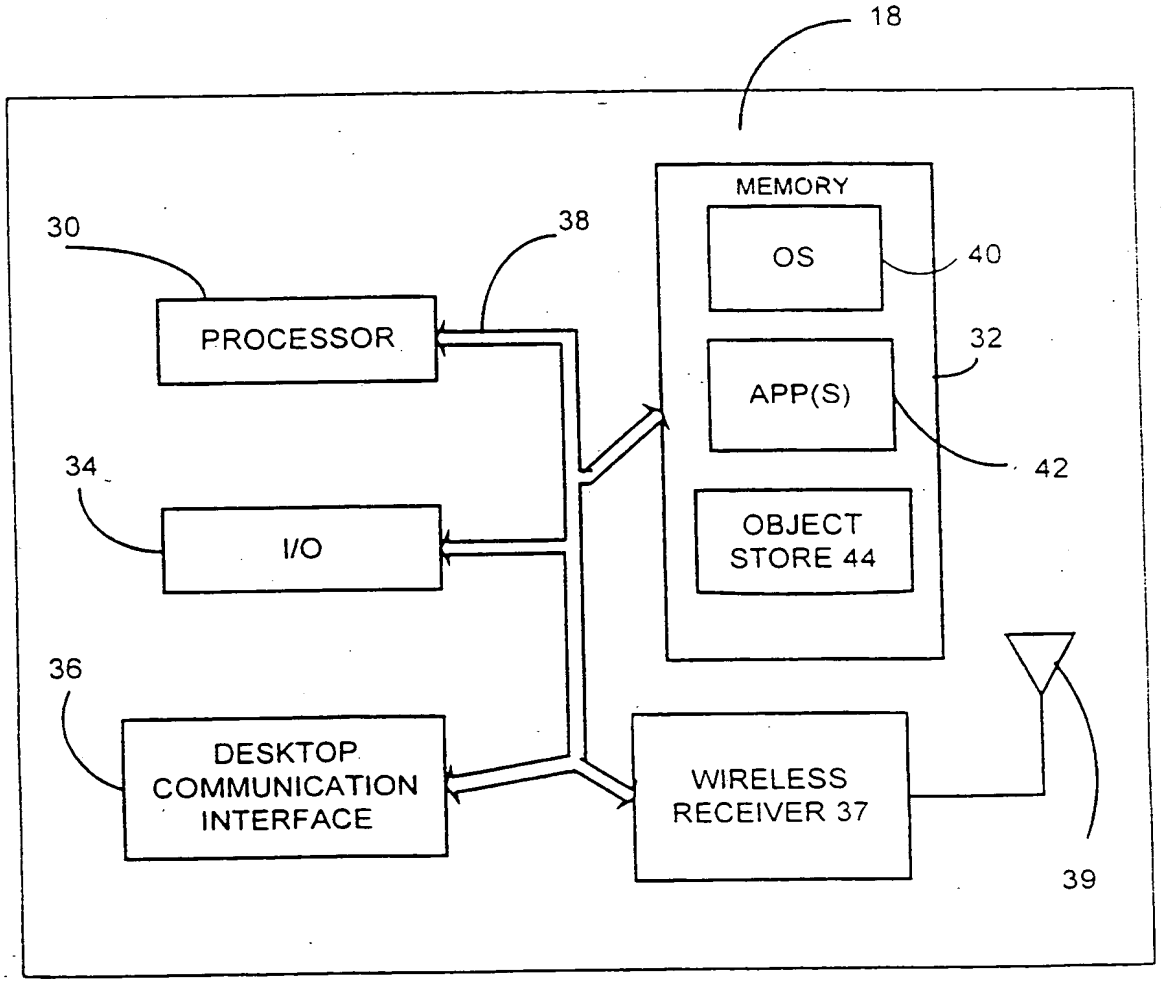


FIG.2

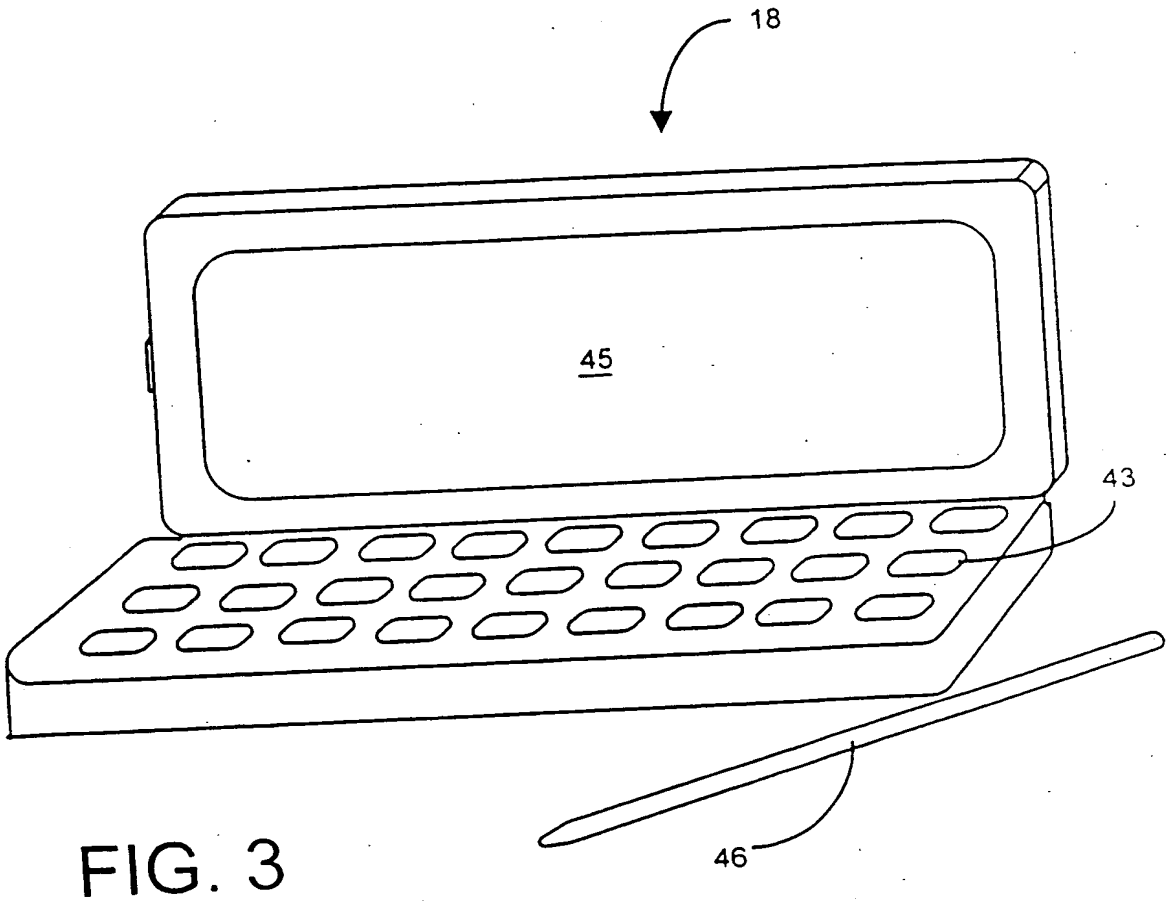


FIG. 3

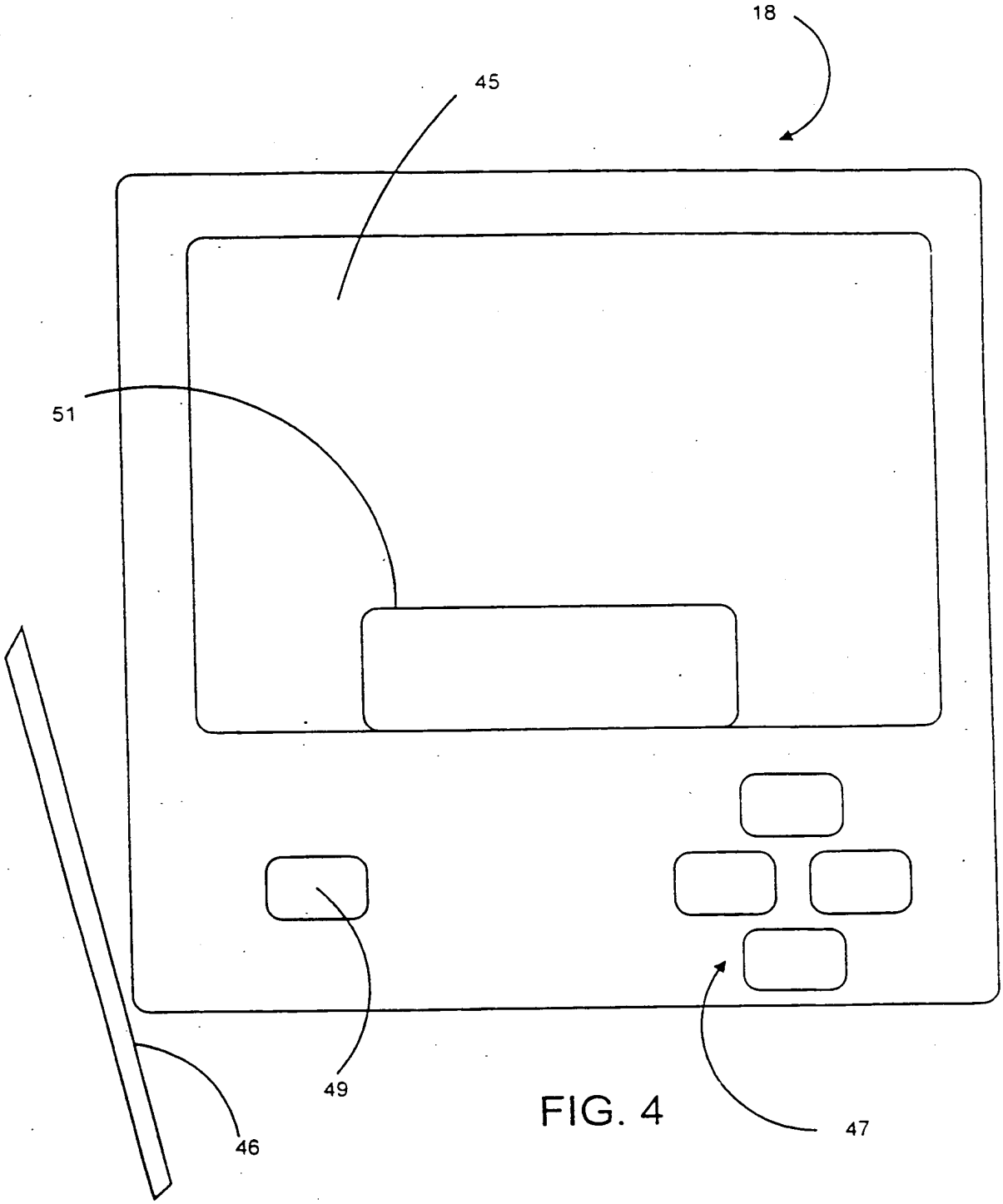


FIG. 4

FIG. 5

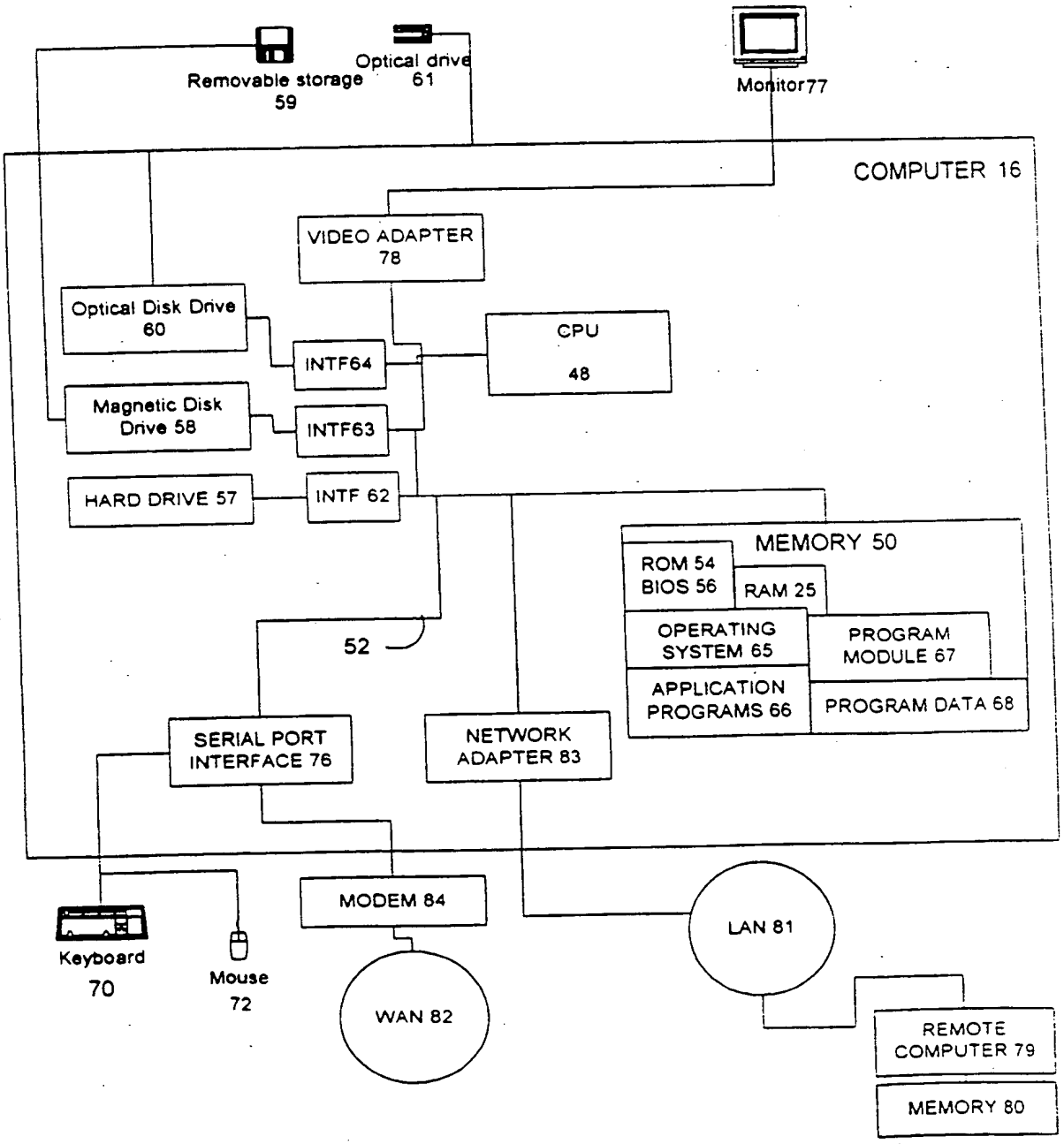
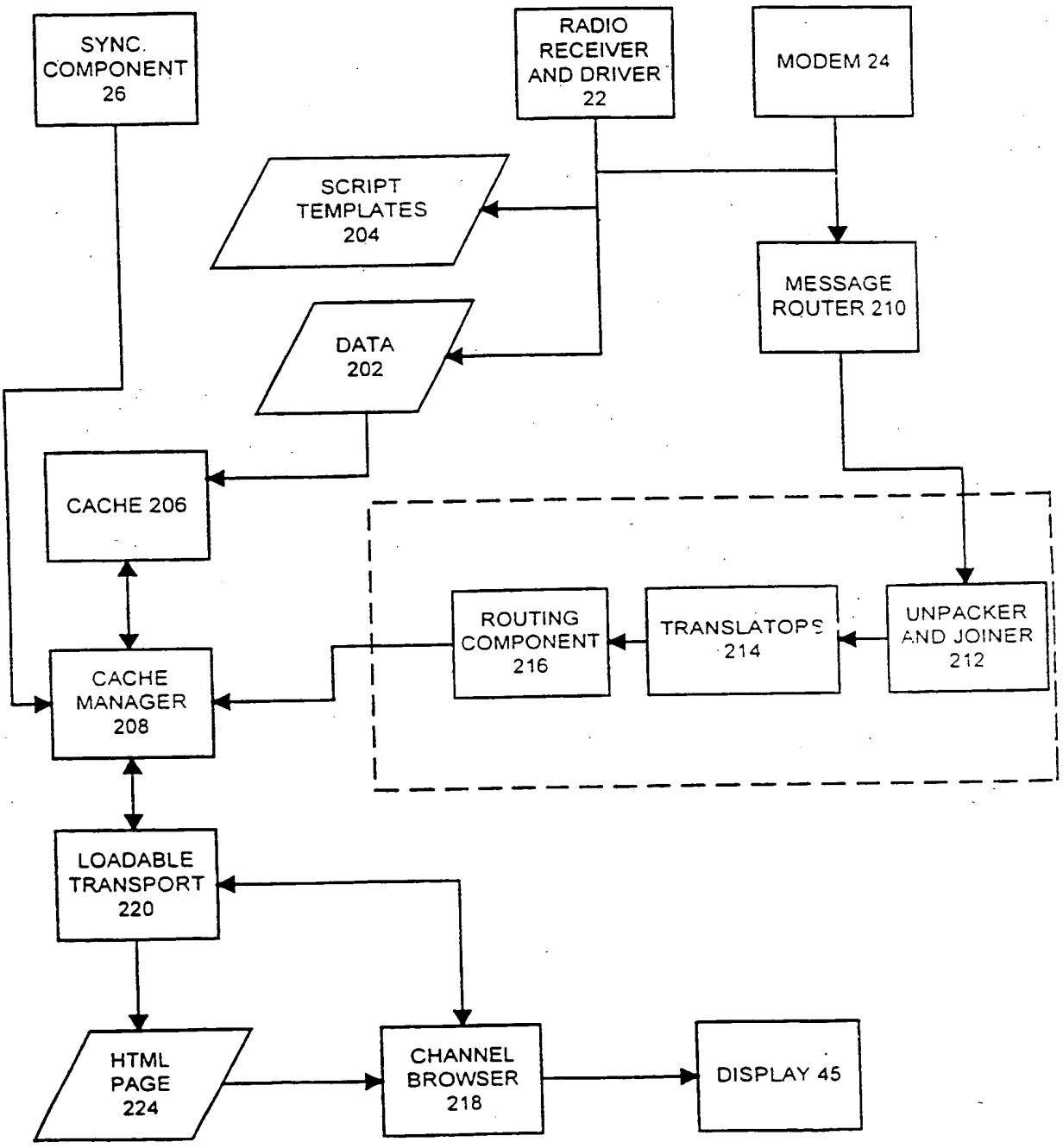


FIG. 6



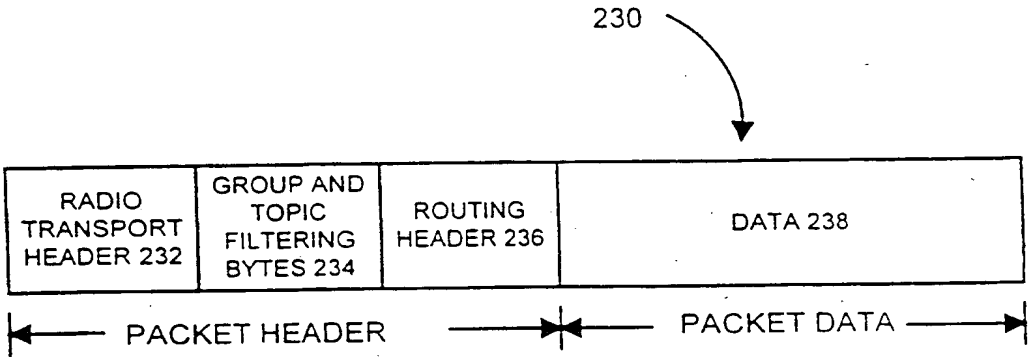
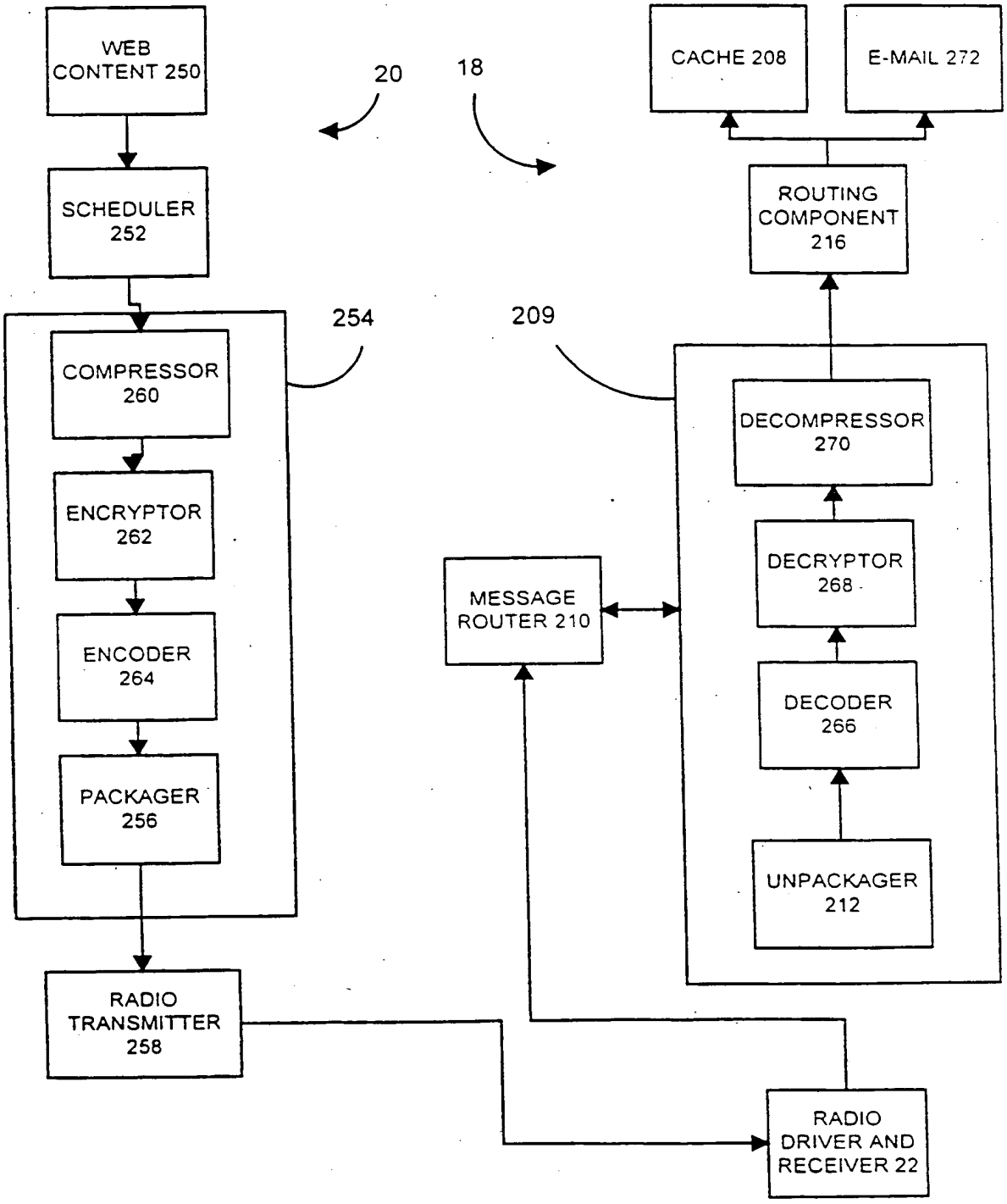


FIG. 7

FIG. 8



INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/US 99/00336

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KAASHOEK M F ET AL: "DYNAMIC DOCUMENTS: MOBILE WIRELESS ACCESS TO THE WWW" PROCEEDINGS, WORKSHOP ON MOBILE COMPUTING SYSTEMS AND APPLICATIONS,8 December 1994, pages 179-184,. XP002016896 see abstract see page 179, right-hand column, line 20 - page 180, left-hand column, line 2 see page 180, left-hand column, line 36 - line 44 see page 180, right-hand column, line 32 - line 46 --- -/--	1,20

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 June 1999	25/06/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Adkhis, F

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INTERNATIONAL SEARCH REPORT

Inter ›nal Application No
PCT/US 99/00336

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	VITALI F ET AL: "Extending HTML in a principled way with displets" COMPUTER NETWORKS AND ISDN SYSTEMS, vol. 29, no. 8-13, 1 September 1997, page 1115-1128 XP004095309 see abstract see page 1116, left-hand column, line 3 - line 14 see page 1116, left-hand column, line 27 - line 39 see page 1125, right-hand column, line 4 - page 1126, left-hand column, line 17	1-32

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